MERRIMACK RIVER BASIN
AMESBURY, MASSACHUSETTS

BAILEY POND DAM
MA 00180

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

DECEMBER 1979

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Amesbury, Mass.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Bailey Pond Dam is a 180 foot long earth embankment with concrete walls forming a portion of the upstream face of the dam and the approach channel to the spillway. The height of the dam is 15 ft. which is the height of the inlet chamber below the spillway. The dam and spillway are generally in fair condition. A test flood equal to ½ the PMF was selected.

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BAILEY POND DAM

MA 00180

MERRIMACK RIVER BASIN
AMESBURY, MASSACHUSETTS

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION
PROGRAM

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PROGRAM

PHASE I INSPECTION REPORT

BRIEF ASSESSMENT

Identification No.: MA00180

Name of Dam: Bailey Pond

Town: Amesbury

County and State: Essex County, Massachusetts

Stream: Unnamed tributary to Merrimack River

Date of Inspection: November 30, 1979

Bailey Pond Dam is a 180-foot long earth embankment with concrete walls forming a portion of the upstream face of the dam and the approach channel to the spillway. The dam was reportedly built in 1912. The top of the dam varies from elevation (El) 30.6 to 33.9, but the low point for hydraulic purposes is the top of the concrete walls at El 31.0. The height of the dam is 15 feet which is the height of the inlet chamber below the spillway. A parking lot and road are located immediately downstream of the dam and are nearly level with the top of the dam. The spillway is an ungated 3.6-foot long weir located about 70 feet north of the south abutment of the dam. The crest of the spillway is at El 27.5. Water discharges into an inlet chamber and then into a 24-inch diameter conduit with an invert at El 19.0. The conduit leads to an 18-inch diameter pipe that discharges into the Merrimack River, which is tidal in this area. There is no low-level outlet for the pond.

There are deficiencies which should be corrected to assure the continued performance of this dam. This conclusion is based on the visual inspection of the site, a review of available data, and limited operating and maintenance procedures.

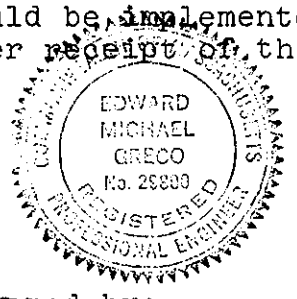
The dam and spillway are generally in fair condition. The following deficiencies were observed at the

site: erosion and spalling of the concrete walls, the lack of riprap on the earth portions of the upstream face of the dam, and the lack of a low-level outlet.

Based on Corps of Engineers' guidelines, the dam is placed in the "small" size and "significant" hazard categories. The drainage area for the dam is 550 acres (0.86 square miles). A test flood equal to a 100-year flood, approximately one-quarter of the probable maximum flood, was used to evaluate the capacity of the spillway. The test flood inflow was determined to be 290 cubic feet per second (cfs). Adjusting for surcharge storage, the test flood outflow was determined to be 215 cfs with the pond at El 31.85. The spillway and downstream conduit can discharge 45 to 51 cfs, depending on the tide level in the Merrimack River, when the pond is at El 31.0 (top of concrete walls). The spillway can therefore discharge 21 to 24 percent of the test flood outflow before the dam is overtopped.

It is recommended that the Owner employ a qualified registered engineer to conduct a more detailed hydraulic/hydrologic study of the spillway and downstream conduits and to evaluate the need for a low-level outlet for the pond. In addition, the Owner should repair the deficiencies listed above, as described in Section 7.3 and continue regular maintenance of the trash racks upstream of the spillway. The Owner should also implement a program of annual technical inspections, a plan for surveillance of the dam during and after heavy rainfall and a plan for warning personnel in downstream areas in case of an emergency at the dam.

The measures outlined above and in Section 7 should be implemented by the Owner within one year after receipt of this Phase I Inspection Report.



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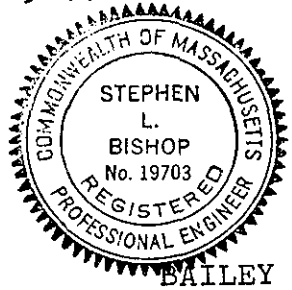

This Phase I Inspection Report on Bailey Pond Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions and recommendations are consistent with the *Recommended Guidelines for Safety Inspection of Dams*, and with good engineering judgment and practice, and is hereby submitted for approval.

CHARLES G. TIERSCH, Chairman
Chief, Foundation and
Materials Branch
Engineering Division

FRED J. RAVENS, JR., Member
Chief, Design Branch
Engineering Division

SAUL C. COOPER, Member
Chief, Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in Recommended Guidelines for Safety Inspection of Dams, for a Phase I Investigation. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general conditions and the downstream damage potential.

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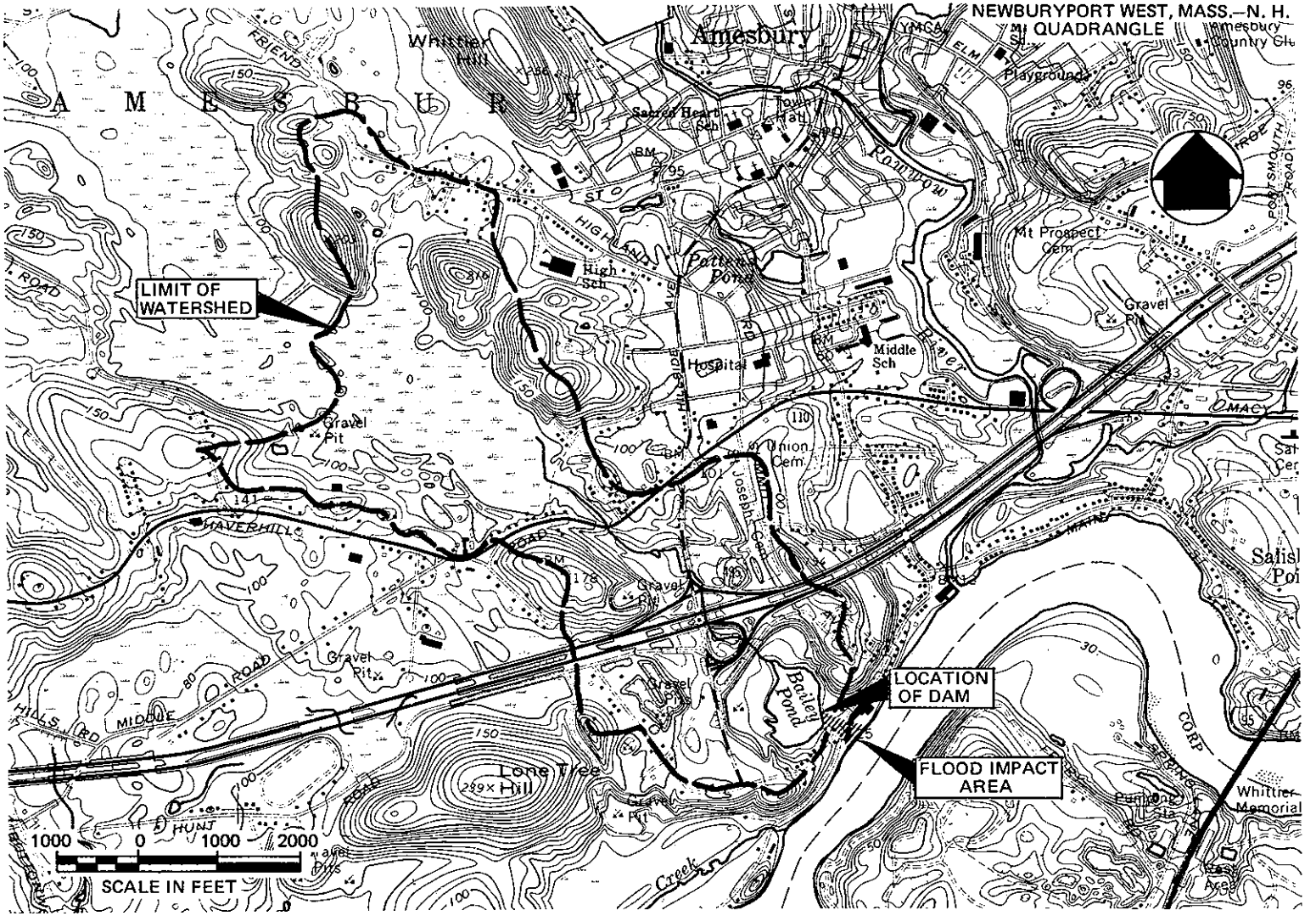


LOCATION MAP – BAILEY POND DAM

NATIONAL DAM INSPECTION
PROGRAM

PHASE I INSPECTION REPORT

BAILEY POND DAM

SECTION 1

PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspection throughout the United States. The New England Divison of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Metcalf & Eddy, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Massachusetts. Contract No. DACW 33-79-C-0054, dated March 27, 1979, has been assigned by the Corps of Engineers for this work.

b. Purpose:

(1) Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

(2) Encourage and assist the States to initiate quickly effective dam safety programs for non-Federal dams.

(3) Update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location. The dam is located on an unnamed tributary of the Merrimack River in the Town

of Amesbury, Essex County, Massachusetts (see Location Map). The coordinates of this location are latitude 42 degrees 50.3 minutes north and longitude 70 degrees 56.0 minutes west.

b. Description of Dam and Appurtenances. Bailey Pond Dam is an earthfill embankment about 180 feet long with concrete walls along a portion of the upstream face (see Figures B-1 and B-2 in Appendix B and photographs in Appendix C). The height and top width of the dam are unclear because a parking lot and residential property are located immediately downstream and nearly level with the top of the dam. A height of 15 feet was chosen, based on the height of the inlet chamber downstream of the spillway weir. The top of the dam is approximately 10 to 30 feet wide, as measured from the upstream edge to the edge of the pavement of the parking lot. The top of the dam varies from El 30.6 to El 33.9, however, hydraulic analyses are based on the lowest point of overflow being the top of the concrete wall at El 31.0. About a 60-foot length of the upstream face of the dam is comprised of vertical concrete walls. The remaining sections, 50 feet to the south and 70 feet to the north of the walls, are earth slopes at 2:1 to 2.5:1 (horizontal:vertical)

The spillway is a 3.6-foot long, ungated concrete weir located about 70 feet north of the south abutment of the dam. The spillway discharges into a 17-foot by 9-foot inlet chamber (see Section B-B on Figure B-2). The crest of the spillway is at El 27.5. The 20-foot long approach channel is formed by concrete wing walls that tie into the walls on the upstream face of the dam. Two trash racks are located across the approach channel about 5 feet and 12 feet upstream of the spillway. A steel plate covers the approach channel from the spillway to the first upstream trash rack.

Discharge from the spillway flows down stepped granite slabs and into an inlet chamber constructed of mortared stone. The floor of

the chamber is at El 16.0. The downstream (east) wall of the chamber contains three discharge pipes. Two of these, 14 inches and 18 inches in diameter, are sealed off. The pipe presently in use is a 24-inch concrete pipe with an invert at El 19.0. This discharge pipe leads to a manhole and then to a catch basin, both on Merrimack Street. From the catch basin, a 24-inch diameter, vitrified clay pipe carries the flow through the existing factory buildings. At this time, the water is not being used for manufacturing processes. The pipe leads to an 18-inch vitrified clay pipe that discharges into the Merrimack River at the south end of the buildings. The downstream invert of the pipe is at about El 0.5.

There is no low-level outlet for the dam.

c. Size Classification. Bailey Pond Dam is in the "small" size category since it has a maximum height of 15 feet and a maximum storage capacity of 95 acre-feet.

d. Hazard Classification. Several three-story factory buildings are located about 250 feet downstream of the dam (see overview photo). A paved parking lot for the factory and Merrimack Street are located between the dam and the factory buildings. Failure of the dam is unlikely due to the volume of earth and the flat slope downstream. However, if the dam were to fail, appreciable property damage and loss of a few lives could occur. Accordingly, the dam has been classified in the "significant" hazard category.

e. Ownership. The dam has been owned since 1977 by the Towle Manufacturing Company, 260 Merrimac Street, Newburyport, Massachusetts 01950. Mr. Lawrence C. Hoyt, Plant Engineer (telephone 617/462-7111) granted permission to enter the property and inspect the dam.

f. Operators. There are no operating facilities at this dam. The structure is maintained and inspected by personnel from the Amesbury plant operations office of the Towle Manufacturing

Company, which is one of the factories located downstream of the dam.

g. Purpose of the Dam. Bailey Pond Dam was originally used to store water for manufacturing purposes. At the present time, the pond is used for recreation such as swimming and boating.

h. Design and Construction History. The only records available on the design and construction of Bailey Pond Dam are previous inspection reports from the Essex County Engineer's office and the Massachusetts Department of Public Works, District 5 office (pages B-4 through B-14 in Appendix B).

The earliest inspection report, dated 1916, states that the dam was built in 1912. A sketch of the dam indicates that flashboards were located on the spillway crest and the original discharge pipe was 16 inches in diameter. In 1933, the concrete wall on the upstream face of the dam was extended 30 feet to the north and a new inlet chamber was constructed. By 1947, the concrete walls were severely cracked and deteriorated.

On November 9, 1977, the dam was overtopped, according to personnel at Towle Manufacturing Company. Records from the U.S. Weather Bureau in Newburyport, Massachusetts show that the rainfall on that day was 4.74 inches in 24 hours. Overtopping was reportedly due to the discharge conduit being partially collapsed. After the storm, a portion of the conduit from the dam to Merrimack Street was replaced with 24-inch diameter concrete pipe. A new manhole was also installed at Merrimack Street. Portions of the concrete walls of the dam and spillway have also been repaired recently.

i. Normal Operating Procedures. There are no operating procedures at Bailey Pond Dam. Personnel from the Amesbury Plant operations office of the Towle Manufacturing Company reportedly visit the dam regularly to clean debris from the trash racks. There are no controls on the spillway or discharge pipe, and there is no low-level outlet for the dam.

1.3 Pertinent Data

a. Drainage Area. The 550-acre (0.86 square mile) drainage area is sparsely developed and lightly wooded (see Drainage Area shown on Location Map). Approximately 24 percent of the drainage area is comprised of swamps and small ponds. The topography is flat to gently rolling with a slope of about 1.5 percent. A number of roadway embankments intersect the drainage area, including an interchange for Route 495. The culverts through these embankments have been designed to provide for a 50-year storm (see page B-14 in Appendix B). A number of gravel pits are also located in the drainage area.

b. Discharge at the Dam Site. Normal discharge from Bailey Pond flows over a 3.6-foot long, ungated weir and into an inlet chamber. The crest of the spillway is at El 27.5. A 24-inch diameter concrete pipe with an invert at El 19.0 carries the flow from the inlet chamber to a manhole and catch basin located 180 feet downstream on Merrimack Street.

Hydraulic analyses indicate that the spillway and discharge conduit can discharge between 45 and 51 cfs, which is 21 to 24 percent of the test flood outflow (one-quarter PMF) when the pond is at El 31.0 (top of the concrete walls). The rate of discharge depends on the tidal level of the Merrimack River, into which the discharge eventually flows. The test flood outflow of 215 cfs with the pond at El 31.85 will overtop the concrete walls by 0.85 feet.

Maintenance personnel of the Amesbury plant operations office of Towle Manufacturing Company report that the dam was overtopped on November 9, 1977 when the recorded rainfall was 4.74 inches in 24 hours. The overtopping was believed to be due primarily to partial collapse of the discharge conduit. The damaged section of the conduit was replaced that year. There is no data available on the performance of the dam and spillway during the storms of record.

c. Elevation (feet above the National Geodetic Vertical datum of 1929 (NGVD)). A benchmark at El 17.4(+), referenced on plans provided by Towle Manufacturing Company and indicated on Figure B-1 of Appendix B, was used at the time of inspection.

(1) Top of dam - 30.6 to 33.9
31.0 - overflow point at top of concrete walls

(2) Test flood pool: 31.85

(3) Design surcharge (original design): *Unknown*

(4) Full flood control pool: Not Applicable (N/A)

(5) Recreation pool: 27.5

(6) Spillway crest: 27.5

(7) Upstream portal invert diversion tunnel: N/A

(8) Stream bed at centerline of dam: 16.0 (floor of inlet chamber)

(9) Maximum tailwater: N/A

d. Reservoir

(1) Length of maximum pool: 1,100 feet

(2) Length of recreation pool: 1,100 feet

(3) Length of flood control pool: N/A

e. Storage (acre-feet)

(1) Test flood surcharge: 106

(2) Top of dam: 95

(3) Flood control pool: N/A

(4) Recreation pool: 50

(5) Spillway crest: 50

f. Reservoir Surface (acres)

*(1) Top of dam: 13.0

*(2) Test flood pool: 13.0

(3) Flood control pool: N/A

(4) Recreation pool: 13.0

(5) Spillway crest: 13.0

g. Dam

(1) Type: earth embankment, concrete walls on portion of upstream face.

(2) Length: 180 feet

(3) Height: 15 feet

(4) Top width: 10 to 30 feet

(5) Side slopes: upstream - vertical to 2.0-2.5:1
downstream - level with parking lot

(6) Zoning: unknown

(7) Impervious core: unknown

(8) Cutoff: unknown

(9) Grout curtain: unknown

h. Spillway

(1) Type: broad-crested

(2) Crest length: 3.6 feet

(3) Crest elevation: 27.5

*Based on the assumption that the surface area will not significantly increase with changes in pond elevation from 27.6 to 31.0.

(4) Gates: None

(5) Upstream channel: 20-foot long with concrete side walls and gravel floor; two trash racks

(6) Downstream channel: stone masonry inlet chamber leading to 24-inch concrete discharge conduit.

i. Regulating Outlets. There is no low-level regulating outlet at this dam. There are no gates to control discharge over the spillway or through the discharge conduit.

SECTION 2

ENGINEERING DATA

2.1 General. There is one drawing of the spillway and inlet chamber available from Towle Manufacturing Company (see Figure B-2 in Appendix B). There are no other plans, specifications or drawings available relative to the design, construction or repair of this dam. Previous inspection reports were obtained from the Essex County Engineer's office and from the Massachusetts Department of Public Works, District 5 (see copies in Appendix B).

We acknowledge the assistance and cooperation of the Essex County Engineering Department; the Commonwealth of Massachusetts Department of Public Works; and Mr. Lawrence C. Hoyt of the Towle Manufacturing Company.

2.2 Construction Records. There are no construction records or as-built drawings for the dam. Previous inspection reports by the Essex County Engineering Department provided some construction information and a summary of repairs and post-construction changes at the site.

2.3 Operating Records. No operating records are available, and there is no daily record kept of the pool elevation or rainfall at the site.

2.4 Evaluation

a. Availability. There is no engineering data available for this dam.

b. Adequacy. The lack of detailed hydraulic, structural and construction data did not allow for a definitive review. Therefore, the evaluation of the adequacy of this dam is based on the visual inspection, past performance history and engineering judgment.

c. Validity. Comparison of the available data with the field survey conducted during the inspection indicates that the available information is valid for the Phase I assessment.

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General. The Phase I Inspection of the dam at Bailey Pond was performed on November 30, 1979. A copy of the inspection checklist is included in Appendix A. Previous inspection reports were conducted by the Essex County Engineer's Office from 1916 to 1967 and by the Massachusetts Department of Public Works in 1971 and 1973. Copies of those reports are included in Appendix B.

b. Dam. The dam is an earth embankment with concrete walls along a portion of the upstream face. The top of the dam is earth with some grass. There is no riprap protection on the earth portions of the upstream face of the dam. Riprap is necessary to protect the slopes from erosion. At the north end of the concrete wall, there is a heavily trespassed area about 15 feet wide which is used for launching boats. Most of the area downstream of the dam has been filled in and paved to form a parking lot, which slopes at about 3 percent away from the dam. Minor cracking of the pavement was observed in the vicinity of the discharge conduit, apparently due to settlement of the backfill placed over the conduit. Near the south abutment, the downstream area is also filled in and forms residential property.

c. Appurtenant Structures. A spillway and inlet chamber are located about 70 feet north of the south abutment of the dam. The approach channel is constructed of concrete side walls that tie into the walls on the upstream face of the dam. There is localized erosion, cavitation and spalling of the concrete walls on the upstream face of the dam and the approach channel to the spillway. Two trash racks across the approach channel are slightly corroded. The trash racks were clear of

debris at the time of inspection. It would be important to maintain this condition, considering that the spillway opening is small and there is no other outlet for the dam. There are keyways for stoplogs in the sides of the approach channel at two locations. However, stoplogs are not currently in use. Water about 1 foot deep was flowing over the spillway at the time of the inspection. Mention is made (Figure B-2 in Appendix B) of minor leakage through the stone masonry walls of the inlet chamber, but no leakage was observed at the time of the inspection.

d. Reservoir Area. The area around Bailey Pond is partially wooded with light residential development. There are several gravel pits located around the pond. Major highway embankments traverse the drainage area.

e. Downstream Channel. Water discharging from Bailey Pond is carried through underground conduits. The section from the dam to Merrimack Street and the manhole was in good condition, water was flowing freely, and there was no debris in the manhole. The only other visible section of conduit was the 18-inch vitrified clay pipe at the downstream end where water discharges into the Merrimack River. The water was flowing freely, but the pipe is deteriorating and in fair condition.

3.2. Evaluation. The above findings indicate that the dam and spillway are in fair condition. There are some deficiencies which require attention. Recommended measures to improve these conditions are stated in Section 7.3.

SECTION 4

OPERATING PROCEDURES

4.1 Procedures. There are no operating facilities and no operating procedures for this dam. Personnel from the Towle Manufacturing Company reportedly visit the dam regularly to clean debris from the trash racks.

4.2 Maintenance of Dam. Some repairs have recently been made to the concrete walls of the dam. However, further repair is needed and riprap should be placed on the upstream slope of the dam.

4.3 Maintenance of Operating Facilities. Removal of debris from the two trash racks is done on a regular basis. Also a portion of the discharge conduit was replaced in 1977. The condition of the remaining portion of the discharge conduit should be investigated. Also, a low-level outlet should be installed to draw down the pond if necessary.

4.4 Description of Any Warning System in Effect. There is no warning system in effect at the dam.

4.5 Evaluation. Although a program of regular maintenance is conducted at the dam, further repairs are needed. There are no programs for regular technical inspections, surveillance of the dam during storms, or for warning people in the downstream areas in case of an emergency at the site. This is undesirable considering that the dam is in the "significant" hazard category. These programs should be implemented as discussed in Section 7.3.

SECTION 5

HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. General. The drainage area of Bailey Pond is 0.86 square miles. Although several roadway embankments intersect this drainage area, they do not significantly restrict storm runoff. Discharge from the pond flows over a 3.6-foot long spillway and into a 24-inch diameter conduit which reduces to an 18-inch diameter conduit farther downstream. Flow is finally discharged into the Merrimack River. There is no low-level outlet for the pond. The maximum storage capacity of Bailey Pond Dam is estimated to be 95 acre-feet.

b. Design Data. There are no hydraulic or hydrologic computations available for the design of this dam.

c. Experience Data. Hydraulic records are not available for this dam. Overtopping of the dam reportedly occurred on November 9, 1977 when a rainfall of 4.74 inches in 24 hours was recorded at the U.S. Weather Bureau in Newburyport, Massachusetts. There are no other data to indicate the performance of the spillway during the storms of record.

d. Visual Inspection. There are two trash racks upstream of the spillway which prevent debris from flowing downstream. The crest of the spillway is constructed such that the opening is only 2.5 feet high and 3.6 feet long. The floor of the inlet chamber is 3 feet below the invert of the discharge conduit. There is no low-level outlet for the dam.

e. Test Flood Analysis. Bailey Pond Dam has been classified in the "small" size and "significant" hazard categories. According to the Corps of Engineers' guidelines, a test flood ranging from a one-quarter to a one-half PMF should be used to evaluate the capacity of the spillway. The one-quarter PMF was selected for this analysis.

The PMF rate for the drainage area directly tributary to Bailey Pond was determined to be 1,350 cfs per square mile. This calculation is based on the average slope of the drainage area of 1.5 percent, the pond-plus-swamp area to drainage area ratio of 24 percent, and the U.S. Army Corps of Engineers' guide curves for Maximum Probable Flood Peak Flow Rates (dated December, 1977). A point slightly above the guide curve for "flat and coastal" topography was used to determine the PMF rate. Applying the one-quarter PMF to the 0.86 square mile drainage area results in a calculated peak flood of 290 cfs as the inflow test flood. Adjusting for surcharge storage, the maximum discharge rate was determined to be 215 cfs (250 cfs per square mile of drainage area). The resulting test flood pool would be at El 31.85.

Hydraulic analyses indicate that discharge through the spillway is controlled by the downstream conduit and by the tidal stage in the Merrimack River. The conduit can discharge a maximum flow of 51 cfs at mean low water and 45 cfs at mean high water with the pond at El 31.0 (see page D-4 of Appendix D). These flows are 24 and 21 percent of the test flood outflow, respectively.

The elevation at which overtopping of the dam would begin is the top of the concrete walls at El 31.0. There is a small area at the north end of the concrete walls where the top of the dam is at El 30.6. This area would be overtopped first, but due to its small capacity, it has been discounted in the hydraulic analyses. Overtopping of the dam would occur in an area about 125 feet wide, extending from the south abutment of the dam to about 15 feet north of the concrete wall. The dam would be overtopped by a maximum of 0.85 feet during the test flood. The depth at critical flow would be 0.50 feet with a velocity of about 4 feet per second.

f. Dam Failure Analysis. Failure of the dam is unlikely to occur due to the volume of earth and the flat slope downstream of the dam. However, if failure of the dam did occur, with the pond at El 31.0, the peak discharge rate is estimated to be 1,100 cfs, assuming a breach 24 feet wide with a failure head of 9 feet. Water would flow across Merrimack Street and then partially down Valley Road and partially into the factory buildings. It is likely that this flood would result in appreciable damage in the factory buildings and possible loss of a few lives. Accordingly, the dam has been placed in the "significant" hazard category.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. The evaluation of the structural stability of Bailey Pond Dam is based on a review of previous inspection reports and the visual inspection conducted on November 30, 1979. As discussed in Section 3, Visual Inspection, the dam is considered to be in fair condition. The concrete walls on the upstream face of the dam and the approach channel of the spillway are eroded and spalled. Also, there is no riprap protection on the earth portions of the upstream face of the dam.

The area downstream of the dam has been filled in to form a parking lot and Merrimack Street. Most of the area is paved with bituminous concrete. This condition provides stability for the dam and protection from erosion.

b. Design and Construction Data. A previous inspection report indicates that Bailey Pond Dam was constructed in 1912. There are no construction records available. Information does not appear to exist on the type, shear strength or permeability of the soil and/or rock materials of the embankment.

c. Operating Records. There is no instrumentation of any type in the embankment at Bailey Pond Dam, and no instrumentation was ever installed at this site. The performance of the concrete dam and/or embankment under prior loading can only be inferred from physical evidence at the site.

d. Post-Construction Changes. Previous inspection reports provide the only available data on post-construction changes. In 1933, the concrete wall on the upstream face of the dam was extended 30 feet to the north and a

new inlet chamber was constructed. In 1950, the concrete walls were rebuilt using reinforced concrete. Late in 1977, a section of the discharge conduit from the dam to Merrimack Street was replaced with 24-inch concrete pipe. Also, a new manhole for the conduit was installed at Merrimack Street.

e. Seismic Stability. Bailey Pond Dam is located in Seismic Zone No. 3, indicating that there is a potential for major damage due to earthquakes in this area. This classification is based on the intensity of past earthquakes, and does not indicate the probability of such events in the future. The highest intensity earthquakes for this area were VII and VIII on the Modified Mercalli Scale, and occurred in 1727 and 1755, respectively. There is no record of any major seismic events since 1912 when the dam was reportedly built.

There is no data available regarding the embankment and foundation materials at Bailey Pond Dam. However the volume of earth downstream of the dam provides appreciable structural stability and the paved surfaces provide protection from erosion should overtopping occur. Therefore, further evaluation of the seismic stability of the dam is not considered warranted.

SECTION 7

ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. Based upon a review of available data and the visual inspection of the site, the dam and spillway at Bailey Pond have been found to be in fair condition. The following deficiencies must be corrected to assure the continued performance of the dam: spalling and erosion of the concrete walls, riprap missing from the earth portions of the upstream face of the dam, and the lack of a low-level outlet.

Hydraulic analyses indicate that the spillway can discharge a maximum flow of 45 to 51 cfs, depending on the tidal stage of the Merimack River, when the pond is at El 31.0 (top of the concrete walls). A test flood outflow (one-quarter PMF) of 215 cfs will result in the pond at El 31.85 and will overtop the dam by a maximum of 0.85 feet. The spillway can discharge 21 to 24 percent of the test flood before the dam is overtopped.

b. Adequacy. The detailed design and construction data did not allow for a definitive review. Therefore, the evaluation of this dam is based on a review of available data, the visual inspection, past performance and engineering judgment.

c. Urgency. The recommendations and remedial measures outlined below should be implemented by the Owner within one year after receipt of this Phase I Inspection Report.

d. Need for Additional Investigation. Additional investigations to further assess the adequacy of the dam are outlined below in Section 7.2, Recommendations.

7.2 Recommendations. In view of the concerns over the continued performance of the dam, it is recommended that the Owner engage a qualified registered engineer to conduct the following studies and design appropriate remedial measures:

a. evaluate the hydraulic/hydrologic capacity and condition of the spillway and discharge conduits and/or other means of protecting existing structures from damage,

b. investigate the condition of the vitrified clay pipes downstream of Merrimack Street,

c. evaluate the need for a low-level outlet or other means for lowering the pond.

The Owner should implement the recommendations of the engineer.

7.3 Remedial Measures

a. Operating and Maintenance Procedures. It is recommended that the Owner accomplish the following:

(1) repair the concrete walls of the dam and spillway,

(2) provide slope protection on the earth portions of the upstream face of the dam,

(3) continue regular inspection and cleaning of the trash racks upstream of the spillway,

(4) implement maintenance inspections of the dam on a monthly basis with additional inspections after storm. Maintenance should include repair of erosion and clearing of vegetation from the embankment. All repairs should be made in accordance with applicable State regulations.

(5) conduct technical inspections of the dam and spillway on an annual basis,

(6) implement a plan for surveillance of the dam during and after periods of unusually heavy rainfall and a plan for notifying personnel in the factory buildings downstream in the event of an emergency at the dam.

7.4 Alternatives. There are no practical alternatives to the recommendations and remedial measures outlined above.

APPENDIX A

PERIODIC INSPECTION CHECKLIST

BAILEY POND DAM

PERIODIC INSPECTION

PARTY ORGANIZATION

ROJECT BAILEY POND DAM

DATE 11/30/79

TIME 8:00 to 16:00

WEATHER 30°-40° Clear

W.S. ELEV.*28.5 U.S. - DN.S.
*Based on benchmark El 17.4 as indicated on Figure B-1 in Appendix B.

ARTY:

1. L. Taverna
2. R. Weber
3. W. Checchi
4. L. Branagan
5.
6.
7.
8.
9.
10.

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Dam and Embankment	Taverna/Weber/Branagan	
2.	Sluiceway	Taverna/Weber/Branagan	
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

PERIODIC INSPECTION CHECK LIST

PROJECT BAILEY POND DAM DATE 11/30/79

PROJECT FEATURE DAM NAME L. Taverna

DISCIPLINE Geotechnical NAME R. Weber

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT Crest Elevation	Earth embankment with upstream concrete walls at El 31.0
Current Pool Elevation	28.5
Maximum Impoundment to Date	Unknown - overtopped in November 1977
Surface Cracks	Some cracking of pavement in parking lot in vicinity of discharge conduit
Pavement Condition	Not applicable (N/A)
Movement or Settlement of Crest	None visible
Lateral Movement	None visible
Vertical Alignment	Generally flat
Horizontal Alignment	Generally straight
Condition at Abutment and at Concrete Structures	Trespassing at north end of concrete walls, abutments tie into natural ground
Indications of Movement of Structural Items on Slopes	None visible
Trespassing on Slopes	Upstream slope used for recreation
Sloughing or Erosion of Slopes or Abutments	Small boat launching area at North end of concrete walls
Rock Slope Protection - Riprap Failures	None visible
Unusual Movement or Cracking at or near Toes	Downstream toe filled in for parking lot
Unusual Embankment or Downstream Seepage	None visible
Piping or Boils	None visible
Foundation Drainage Features	None visible
Toe Drains	N/A
Instrumentation System	None visible

PERIODIC INSPECTION CHECK LIST

PROJECT BAILEY POND DAM DATE 11/30/79

PROJECT FEATURE SPILLWAY NAME L. Taverna

DISCIPLINE Geotechnical NAME R. Weber

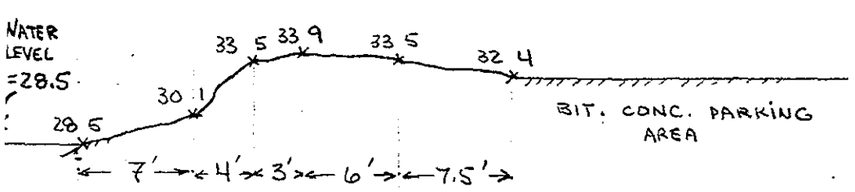
U/S = upstream
D/S = downstream

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	Trashracks - 3.63 ft wide - 1 in spacing 3/8 in. bar - 6.85 ft wide - 1-1/2 in. spacing 3/8 in. bar
a. Approach Channel	
General Condition	Erosion, cavitation below water level on concrete walls
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	None
Floor of Approach Channel	Gravel upstream of trashracks, concrete downstream of trashracks
b. Weir and Training Walls	Concrete
General Condition of Concrete	Some spalling and erosion
Rust or Staining	None visible
Spalling	Minor
Any Visible Reinforcing	None visible
Any Seepage or Efflorescence	None visible
Drain Holes	None visible
c. Discharge Channel (Inlet Chamber)	Stepped granite blocks into an inlet chamber made of mortared stone and concrete
General Condition	Fair
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	N/A
Floor of Channel	Not visible
Other Obstructions	Concrete slab headwall at overflow weir restricts opening to 2.5 ft high.

d. Discharge Conduits:
1. 24-in. concrete pipe at Merrimack Street manhole - conduit flowing freely, no debris in manhole.
2. 18-in. vitrified clay pipe at Merrimack River - pipe flowing freely, but deteriorating.

APPENDIX B

PLANS OF DAM AND PREVIOUS
INSPECTION REPORT



SECTION 1-1

EMBANKMENT SECTION

SCALE 1 IN = 10 FT

SCALE in Feet

0 10 20 30

0 40 80 120

BAILEY POND

WS = 28.5

BIT. CONC PARKING AREA

BEACON STREET

VALLEY ROAD

MERRIMAC STREET

MERRIMACK RIVER (TIDAL)

24" R.C.P.

MANHOLE RIM = 22.3 INV = 14.5

CATCH BASIN RIM = 22.1 INV = 13.4

ACCESS INV.: 6.2 24" Pipe

BUILDING FLOOR EL = 13.5

ARCH PASSAGEWAY

CONDUIT LOCATION APPROXIMATE

CONDUIT LOCATION APPROXIMATE

BENCHMARK ELEV = 17.4 ± (NGVD)

18in. OUTLET EL = 0.5 ABOVE MEAN SEA LEVEL (NGVD)

EMBANKMENT SECTION

LIMITS OF PAVING

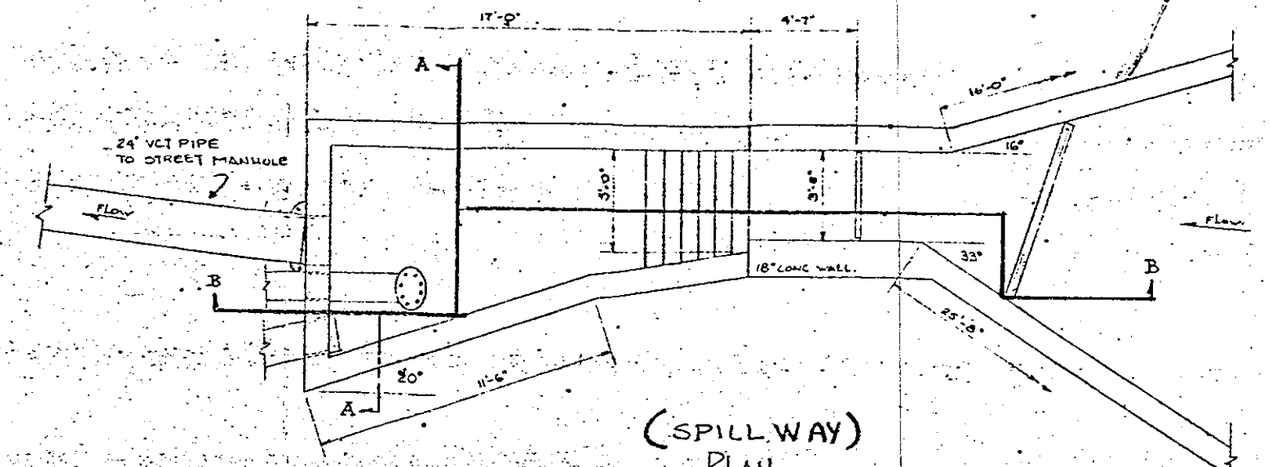
#1 #2 #3 #4 #5 #6

NOTE:

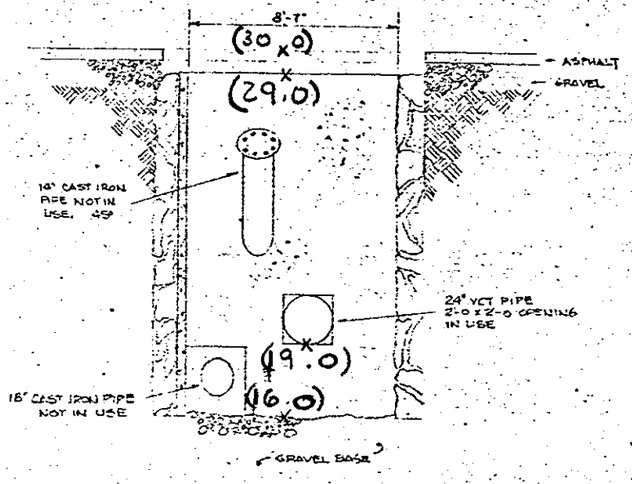
1. Elevations shown based on benchmark established on building as shown on this drawing = El. 17.4 NGVD.
2. Information shown based on actual field survey of 30NOV. 1979, and existing plans from owner.
3. #2 indicates location and direction of view for photographs

METCALF & EDDY, INC. ENGINEERS BOSTON, MA.	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MA.
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	
BAILEY POND DAM	
FIGURE 8-1 PLAN OF DAM	
TRIBUTARY MERRIMACK RIVER	MASSACHUSETTS
SCALE: 1" = 40'	DATE: NOVEMBER, 1979

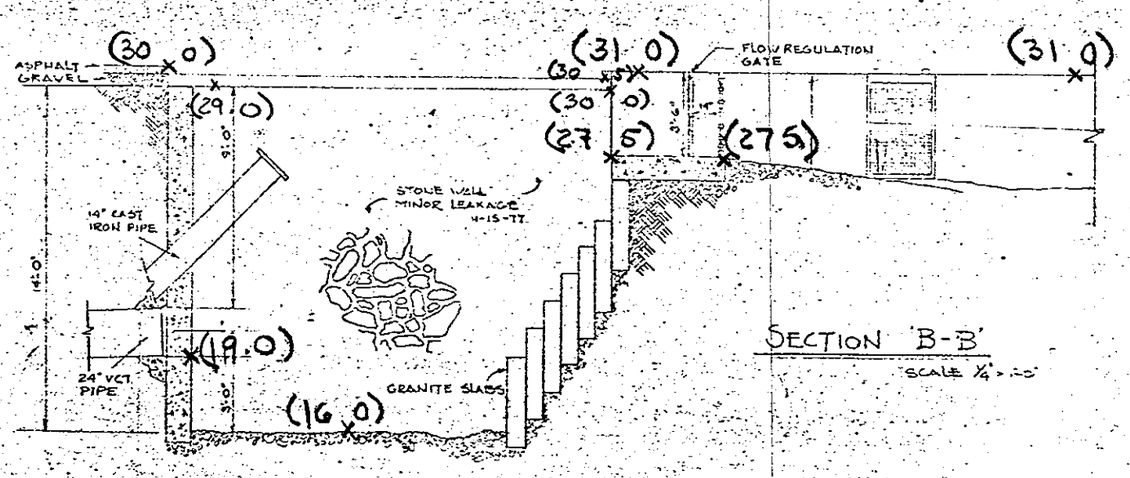
DO NOT SCALE THIS DRAWING



(SPILLWAY)
PLAN
SCALE 1/4" = 1'-0"



SECTION "A-A"
SCALE 1/4" = 1'-0"



SECTION "B-B"
SCALE 1/4" = 1'-0"

NOTE:
① PLAN REDUCED FOR THIS REPORT
② Elevations in parenthesis from field survey of 30 November 1979.

MAT.		TITLE	NO.	ALTERATION	CHG. BY / CHK. BY
DWN. BY	AGF	11-15-77	BAILEY POND OVERFLOW	TOWLE MANUFACTURING CO. NEWBURYPORT, MASS.	
CHK. BY			PROJ. SLUICEWAY, AMESBURY FACILITY	SCALE LC 3/4	ALT.
APP. BY					

OTHERWISE NOTED:
L SHARP EDGES
IMAL ± .003, FRACTIONAL ± 1/64, ANGULAR ± 1/2°

BAILEY POND DAM

FIGURE B-2

OK FILE

INSPECTION REPORT - DAMS AND RESERVOIRS

(1) Location: ~~City~~/Town Amesbury Dam No. 5-5-2-13

Name of Dam Bailey Pond Inspected By: D. P. Horgan

Date of Inspection 12-3-73

(2) Owner/s: per: Assessors Prev. Inspection *

Reg. of Deeds Pers. Contact

1. U.S.M. Corporation, Bailey Division, Elliott St., Beverly, Mass
Name St. & No. City/Town State Tel. No.

2. Name St. & No. City/Town State Tel. No.

3. Name St. & No. City/Town State Tel. No.

(3) Caretaker (if any) e.g. superintendant, plant manager, appointed by absentee owner, appointed by multi owners.
Robert Reeves General Manager - Bailey Division U.S.M Corp. Rte#1 Seabrook N.H
~~U.S.M. Corporation, Bailey Division, Merrimac St., Amesbury, Mass. 02574~~
Name St. & No. City/Town State Tel. No.

(4) No. of Pictures taken

(5) Degree of Hazard (if dam should fail completely)*

1. Minor * 2. Moderate
2. Severe 4. Disastrous

* This rating may change as land use changes (future development)

(6) Outlet Control: Automatic Manual *

Operative * yes ; No.

Comments:

(7) Upstream Face of Dam Condition:

1. Good 2. Minor Repairs *
3. Major Repairs 4. Urgent Repairs

Comments: Concrete face wall badly spalled

DAM NO. 5-5-7-13

8. Downstream Face of Dam: Condition: 1. Good * 2. Minor Repairs
3. Major Repairs 4. Urgent Repairs

Comments: *Paved parking lot.*

9. Emergency Spillway: Condition: 1. Good * 2. Minor Repairs
3. Major Repairs 4. Urgent Repairs

Comments:

10. Water level @ time of inspection: *1.5* ft. above below *
top of dam * principal spillway
other

11. Summary of Deficiencies Noted:

Growth (Trees and Brush) on Embankment

Animal Burrows and Washouts *Some erosion of embankment*

Damage to slopes or top of dam

Cracked or Damaged Masonry *Concrete face wall badly spalled.*

Evidence of Seepage

Evidence of Piping

Erosion

Leaks

Trash and/or debris impeding flow

Clogged or blocked spillway

Other

DESCRIPTION OF DAM

DISTRICT 5 Amesbury

Submitted by Donald P. Horgan Dam No. 5-5-7-13

1. Location: Topo Sheet No. 36 C

Provide 8½" x 11" in clear copy of topo map with location of Dam clearly indicated

2. Year built: Unknown Year/s of subsequent repairs 1950

3. Purpose of Dam: Water Supply ____ Recreational ____

Irrigation ____ Other Industrial

4. Drainage Area 0.9± Sq. mi. ____ acres

5. Normal Ponding Area: 6± Acres ; Ave. Depth ____

Impoundment: ____ gals; ____ acre ft.

6. No. and type of dwellings located adjacent to pond or reservoir ____

i.e. summer homes etc. Dwelling houses

7. Dimensions of Dam: Length ____ Max. Height ____

Slopes: Upstream Face Concrete

Downstream Face Paved parking lot

Width across top ____

8. Classification of Dam by Material:

Earth x Conc. Masonry ____ Stone Masonry ____

Timber ____ Rockfill ____ Other Conc. face wall

9. a. Description of present land usage downstream of Dam ____; travel ____ feet

b. Is there a storage area or flood plain downstream of dam which could accommodate the impoundment in the event of a complete dam failure yes ____ no x

DAM NO. 5-5-7-13

10. Risk to life and property in event of complete failure.

No. of people_____

No. of homes_____

No. of businesses_____

No. of industries 1 Type *Mill*

No. of utilities_____ Type_____

Railroads_____

Other dams_____

Other *Roadway*

11. Attach Sketch of dam to this form showing section and plan on 8½" x 11" sheet.

Large parking area reinforces dam.

DEPARTMENT OF PUBLIC WORKS
DISTRICT 5

INSPECTION OF DAMS AND RESERVOIRS
(CHAPTER 253 OF GENERAL LAWS AS AMENDED
BY CHAPTER 595 OF the ACTS OF 1970)

D 15 — TOWN
AMESBURY
5-5-7-13

INSPECTOR L. E. WILKINSON DATE 6/9/71

LOCATION ON BAILEY POND. BEGIN AT ROUTE 110 (HAVERHILL RD.) AT INTERSECTION OF MAIN ST. - TAKE MAIN ST. SOUTHEAST 0.50 MI. TO MERRIMAC ST. - TAKE MERRIMAC ST. SOUTHERLY 0.40 MI. DAM IS BAC OF PARKING LOT ABOUT 100 FEET WEST OF MERRIMAC ST.

OWNER U.S.M. CORPORATION, BAILEY DIVISION BEVERLY, MASS.

USE WATER STORAGE

MATERIAL & TYPE EARTH WITH CONCRETE FACE WALL - LARGE PARKING AREA REINFORCES DAM - NO CHANCE OF FAILURE

HEIGHT OF DAM _____ TOP ELEVATION OF DAM _____

DATUM M.S.L. 1929 _____ TOP ELEVATION OF SPILLWAY _____

LENGTH _____ TOP WIDTH _____ POND AREA _____

VOLUME OF WATER IMPOUNDED _____ GALLONS

CONTRIBUTORY DRAINAGE AREA _____ SQ. MILES _____ ACRE

DESCRIPTION OF SPILLWAY WATER 18" BELOW TOP OF CONC WALL. TO-DAY - VERY LITTLE DEBRIS AT SCREENS OF OUTLET - WATER ABOUT 1' FOOT DEEP AT OUTLET SCREEN.

RECOMMENDATIONS DAM O.K. OUTLETS SHOULD BE KEPT CLEAR OF DEBRIS.

* PROBABLE DAMAGE IN CASE OF FAILURE 1. SERIOUS 2. MODERATE 3. SLIGHT

COUNTY OF ESSEX, MASSACHUSETTS

ENGINEERING DEPARTMENT

Inspection of Dams, Reservoirs, and Stand Pipes

O/0 1-5 SUB NUMBER

D/5 R. S. 1

Neg. Nos.

O/0 1-C D/5 R. S.P.

Inspector A. C. Woodbury Date Nov 3 1915 *Classification 2

City or Town Amesbury Location "Bailey's" Pond Merrimac St

500' ± from River

Owner Merrimac Hat Co. Use Manufacturing purposes

Include such details as cores, cut off walls, paving, sodding, class of masonry, kind of cement, (nat. or port.) etc.

Material and Type Earth with concrete lining and in forebay & wings.

Elevations in feet: above (+) or below (−) full pond or reservoir level. (Cross out what does not apply.)

For Dam: Bed of stream below ..... Bottom of pond ..... Bottom of spillway ..... Top of dam ..... Top of flash boards

For Res. or S. P.: ~~Ground surface below~~ ..... ~~Bottom of res.~~ ..... Level of over flow pipe ..... ~~Top of res.~~

For dam: Length in ft. ..... Top width in ft. ..... Pond area 6± acres Area of watershed 0.9± sq. mi.

For Res. or S. P.: ~~Inside dimensions~~ ..... ~~Capacity~~ ..... ~~covered~~

Length of overflow or spillway ..... Outlet pipes 3 (size and nature)

~~Stand pipe, thickness at base~~ ..... ~~diam. of rivet head~~ ..... inch [inlet / outlet]

Foundation and details of construction C

Constructed by and date John Mowin in 1912 (Owned and for over 50 years)

Recent repairs and date None

Evidence of leakage Very slight in Spillway

Condition Good ~~S. P. when painted~~ [inside / out]

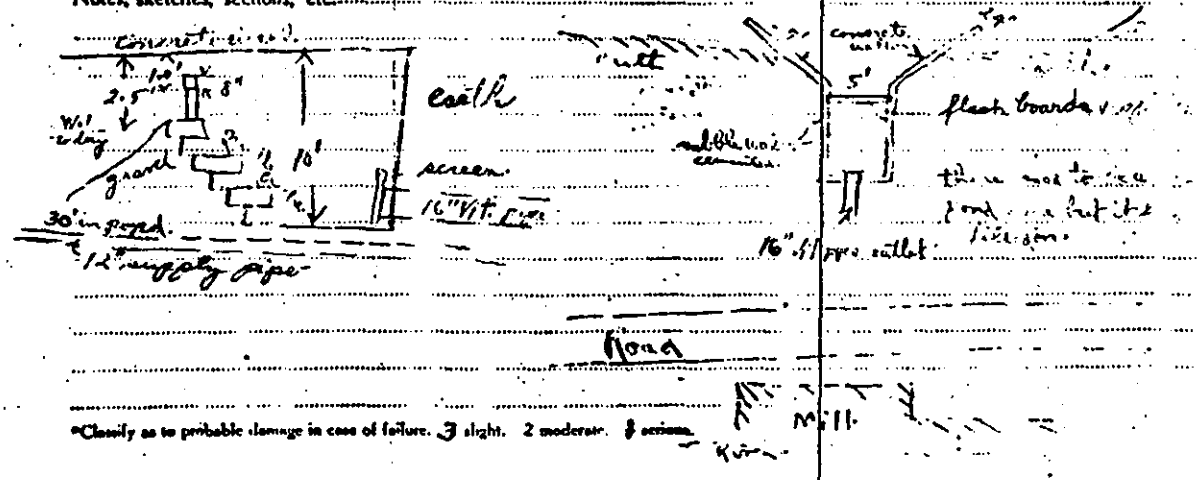
Topography of country below Flat open to river

Nature, extent, proximity, etc. of buildings, roads or other property in danger if failure should occur Street & Hat Co's Factory might be damaged.

Plans and data secured or available B. F. Sargent Jr. (Supt.)

Use separate sheet for sketches if necessary.

Notes, sketches, sections, etc.



*Classify as to probable damage in case of failure. 3 slight. 2 moderate. 1 serious.

Amesbury D. 15

1917, March 26. Watershed 0.9 sq. m. Max. Ht. 8.0 ft. Apparent condition, Good.

1925, Nov. 18. R. R. Evans, Insp. The land below the dam is at substantially the same height as the top of the dam, falling away on a gradual slope. The only outlet is a twenty inch culvert and twelve inch pipe which leads to the mill. Although these are small and the dam might over-flow, it is not apparent that there could be any failure. The water, after crossing the road, would find its way through the yard of the mill. The dam is in fairly good condition.

1925 Report to Co. Comm. Same as above.

1929, Nov. 16. C. C. Barker, Insp. Dam on Bailey's Pond north of Merrimac Street, owned by the Merrimac Hat Corp., is used for manufacturing purposes. It does not seem possible this dam would fail, but it might overflow in a wide sheet of water which would find its way across the road, which is macadam, to the factory and then the river. Their own factory might be damaged from water. On the north side of the road are garages, but it is not likely these would be damaged. There is a gradual slope ffom the top of the dam to the road. The westerly concrete wing wall at spillway is cracked, otherwise the dam is in good condition. Apparently there have been no changes since the last inspection and conditions are the same.

1929 Report to Co. Comm. The dam at Bailey's Pond north of Merrimac St. at the property of the Merrimac Hat Corp., is in good condition, except for the cracking of the concrete wall at the spillway and this apparently is unimportant and the situation such that overflow might occur, but there seems to be no possibility of any damage due to failure of the dam.

1931, Oct. 9. C. C. Barker, Insp. J. Baker, Master Mechanic, told me there had been no changes. The cracks in the west wall near the corner are open about one inch. The screen in front of the spillway is somewhat clogged with weeds. There have been no changes and the conditions are the same as when last inspected. Water low today.

1931 Report to Co. Comm. The dam on Bailey's Pond north of Merrimac St. owned by the Merrimac Hat Corporation is a small affair of very little importance, in fair condition.

1933, Sept. 6. C. C. Barker, Insp. I gave a copy of the notice to E. R. Hall. No one inspected the dam with me. In 1932 the concrete face wall was extended about 30 feet easterly and a new inlet chamber 2.7 foot wide and about 11. feet deep and 12 feet long was built. The inlet of the old 12 inch outlet pipe has been plugged and a new 12 inch pipe leads out of the new inlet chamber into the old pipe. The dam is in good condition except for the cracks in the concrete walls at the spillway. The conditions around the dam are the same.

1933 Report to Co. Com. Safe and in reasonably good condition.

1935. Sept. 24, C. C. Barker, Insp. I left a notice with Mr. Barr for Mr. E. R. Hall. No one went to the dam with me. There have been no changes and the conditions are the same. The cracks in the concrete walls are the same.

1935 Report to Co. Comm. Safe and in reasonably good condition.

1937 July 23, C.C.Barker, Insp. I gave a copy of the notice to E. R. Hall. This dam is in about the same condition. There have been no repairs or changes. The upper face wall is somewhat cracked.

1937 Report to Co. Comm. Safe and in reasonably good condition.

1939 Sept. 6, C.C.Barker, Insp. I gave a copy of the notice to E. R. Hall. The upper concrete face wall is somewhat cracked about the same as when last inspected. No repairs have been made. This dam is in fair condition and there has not been any change.

1939 Report to Co. Comm. Safe and in reasonably good condition.

1941 Oct. 1, C.C.Barker, Insp. I gave a copy of the notice to Mr. Gordon, who went to the dam with me as Mr. Hall was not there. The concrete walls have been repaired and the dam is in good condition. The water level is 7.5 feet below the top of the dam. In 1939 an addition to the hat factory was built at the westerly end.

1941 Report to Co. Comm. Safe and in reasonably good condition.

1943 Sept. 2, S. W. Woodbury, Insp. I gave a copy of the notice to Mr. Gordon, who went to the dam with me. There is a new crack in the concrete wall about eight feet from the corner at the spillway. The old cracks seemed to have opened up some, and the concrete has disintegrated quite badly in some places. Mr. Gordon plans to have this wall strengthened. New planks have been placed over the spillway since the last inspection. The old planks over the inlet chamber need to be replaced. There is a new 3" pipe at the easterly end. Water is used in the condensers and returned to the pond through this pipe. The water level is about 2.5 ft. below the top of the wall.

1943 Report to Co. Comm. At Bailey's Pond Dam, north of Merrimac Street, the concrete face wall has cracked and disintegrated quite badly in some places. Repairs are contemplated here. It is very unlikely that a failure of this dam would result from its present condition.

1945 Aug. 29, S. W. Woodbury, Insp. I gave a copy of the notice to Mr. Gordon, but went to the dam alone. Water level today is 1.2 ft. below top of concrete wall. Condition of the dam is getting worse. Top of concrete is badly disintegrated at corner just east of the westerly trash rack. Cracks look to be worse. Mr. Gordon says that he intends to repair the concrete walls.

1945 Report to Co. Comm. At Bailey's Pond Dam, north of Merrimac Street, the concrete is badly disintegrated and the repairs contemplated have not been made, but should be made, although it is not probably a sudden failure of the dam could occur which would cause serious damage.

1947 Oct. 7, S.W.Woodbury, Insp. Gave a copy of the notice to Mr. Gordon but went to dam alone. Further inspection needed to see that repairs are made to concrete wall. No repairs made since last inspection.

Water level today is 3 ft. below top of concrete wall. Condition of the dam is very poor. The concrete wall just east of the trash rack has fallen into the pond. (That is the top foot of it for about 20 ft.)

1947 Report to Co. Comm. At Bailey's Pond Dam, north of Merrimac Street, the concrete face wall is badly disintegrated and the dam is in very poor condition. Two years ago repairs were contemplated, but have not been made. Repairs should be made and the dam put in good shape, although it is doubtful if a sudden failure would occur and cause serious damage.

1949 Sept. 29, S.W.Woodbury, Insp. Gave a copy of the notice to Mr. Gordon and went to dam alone. Further inspection is needed to see that repairs are made to concrete wall. No repairs since last inspection. Water level today: 4.5 ft. below top of concrete wall. Condition of the dam is very poor. Mr. Buswell, the plant engineer, says that they will repair the wall sometime within the next year.

1949 Report to Co. Comm. At Bailey's Pond Dam, north of Merrimac Street, the contemplated repairs to the concrete face wall, which has been badly disintegrated for some time, have not been made and the dam is in very poor condition. However, it is now understood that repairs will be made within the next year. It is doubtful if a sudden failure would occur and cause serious damage.

1951 Oct. 18, E.H.Page, Insp. Gave a copy of the notice to Mr. Buswell (Plant Engineer). At the dam with Mr. Buswell. Repairs since last inspection: All the conc. in the dam has been replaced with new reinforced concrete. Water level today: 2'-4" below top of concrete. Condition of the dam: Very good.

1951 Report to Co. Comm. At Bailey's Pond Dam all the old concrete walls were in very bad condition have been replaced with new reinforced concrete. The dam is in very good condition now.

1953 Oct. 1, E.H.Page, Insp. Went to dam alone. Water level today: 3.3' below top of conc. Condition of the dam: Same - good.

1953 Report to Co. Comm. Safe and in reasonably good condition.

1954 May 24 E.H.Page, Insp. Elev. of water: 5" over flash boards. 6 1/2" below conc. wall. Height of flashboards; 2'-5" room for 12" more. Minimum freeboard: 0" Dam is in good condition, but the water is kept too high.

1955, Nov. 21, E.H.Page, Insp. Elev. of water: 6 1/2" below top of conc. dam. Height of flashboards: 1'-7" below top of conc. 2 logs as well as leaves in spillway. Although the flashboards are 1'-7" below top of dam, the water is only 6" below the top. This is due to a 3/4" mesh screen placed in front of flashboards to keep fish from getting out of the pond. This screen is now filled with leaves and is holding the water too high. There is evidence of wave action over top of the dam. Whoever put the screen there should either remove it or keep it free from leaves.

1955 Report to Co. Comm. The dam at Baileys Pond at Merrimac Street has a three-quarter mesh screen to keep the stocked fish in the pond. This screen is clogged with leaves and is holding back the water to within six inches of the top of the dam. Whoever put this screen there should keep it free of leaves or remove it. Letter of November 20th from the Bailey Company says screen was removed and to be replaced later by a trash rack.

1957 Dec. 3, E.H.Page, Insp. Elev. of water: 2' 6" below top of conc. Height of flashboards: 1' - 2" below top of conc. Minimum freeboard 0". Condition of dam: Good. The Amesbury Sportsmen Club Inc. have moved a building on the dam just south of the spillway. They keep the water too high in this pond.

1957 Report to Co. Comm. The water in Bailey's Pond is kept much too high with only about one foot freeboard. The Amesbury Sportsman Club, Inc. has moved a building onto the dam as their headquarters. They keep a fish screen over the outlet, which picks up any leaves or debris that comes along. This must be kept free, due to the small amount of freeboard.

1958, Jan. 27, E.H.Page & J.O.Harmaala, Insps. Elev. of water: about 0.1 below top of conc. wing wall. Water is coming around s.end of wing wall. Not much damage yet. They keep the water in this dam much too high.

January 28. Water is now 0.7 below top of conc.

1959 Sept. 14, E.H.Page, Ins. Elev. of water: 20" below top of wall. Lapping over flashboards. Height of flashboards: 1' - 6" Minimum freeboard: 0. Obstructions: A little. The flashboards are at a lower level than last reported. They should never be higher than this, lower, if anything.

1959 Report to Co. Comm. The water in Bailey's Pond is kept too high with only about one foot freeboard, although at the time of inspection one flashboard had been removed to increase the freeboard to twenty inches. The flashboards should never be higher than this, lower if anything. The Amesbury Sportsman Club, Inc. keeps a fish screen over the outlet, which picks up leaves and other debris that comes along. This should be kept free due to the small freeboard.

1961 Dec. 5, E.H.P. & P.D.K. Insps. Probable loss of life in case of failure. Elev. of water: 1" over flashboards. Minimum freeboard with stop logs in place: none. Condition: Same. Water 8" below concrete. Water kept at too high an elevation.

1961 Report to Co. Comm. Bailey's Pond. This pond is kept too high. Water is only eight inches below top of dam. A lot of debris collects in the outlet.

1964, Feb. 10, P.D.K. & K.M.J. Insp. Condition: Same.

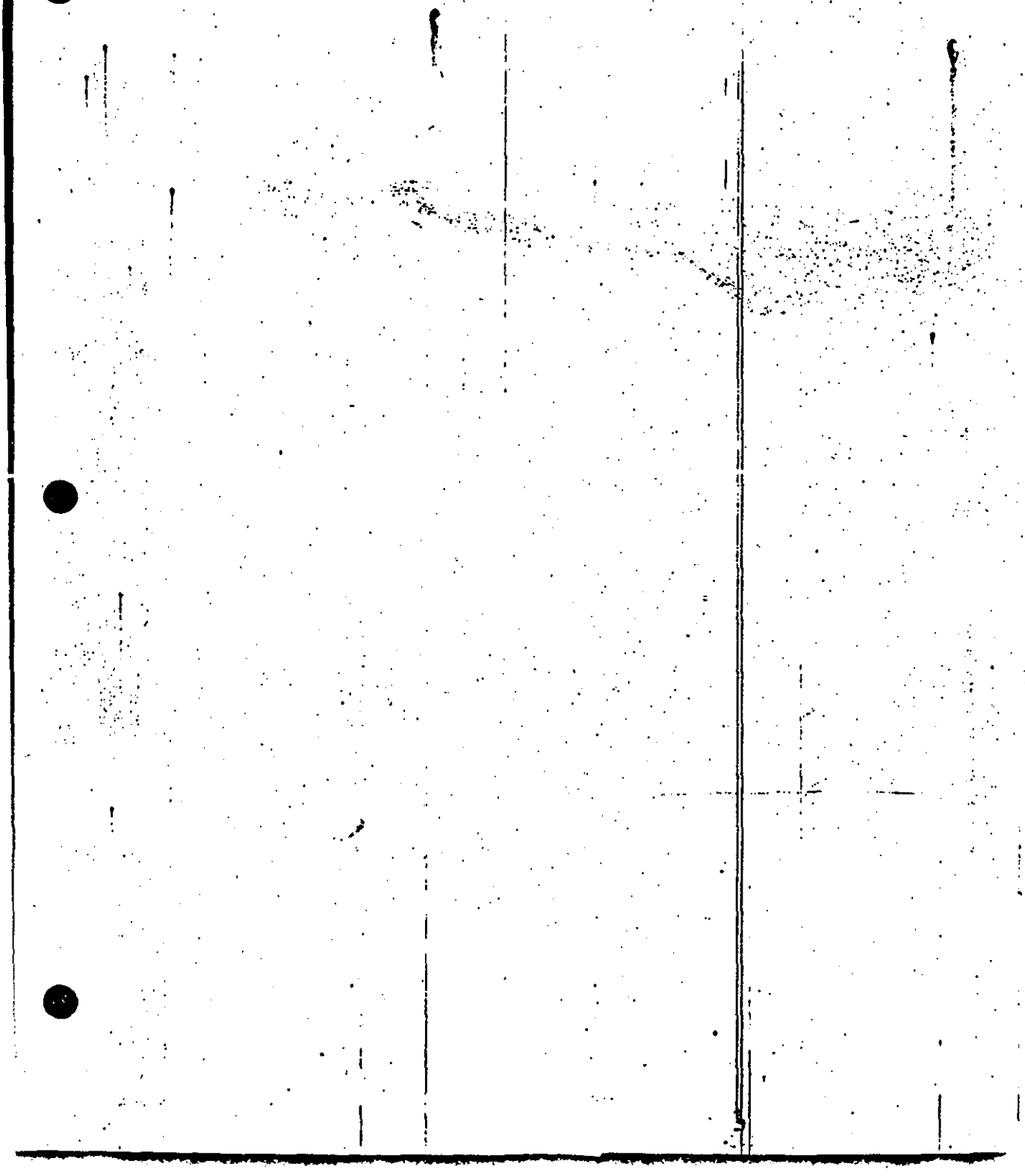
1963 Report to Co. Comm. Bailey's Pond. This pond is kept too high. Water is only eight inches below top of dam. A lot of debris collects in the outlet.

1965 June 9, 1966, P.D.K. Insp. Condition same as 1959 report.

1965 Report to Co. Comm. Safe and in reasonably good condition.

1967 Jan. 23, 1968. P.D.K. Insp. Report same as 1963 report.

1967 Report to Co. Comm. Safe and in reasonably good condition.



The Commonwealth of Massachusetts

Department of Public Works

DISTRICT #5 OFFICE
495 MAPLE STREET, DANVERS

Projects - Amesbury
Drainage into Bailey's Pond

November 16, 1977

Lawrence C. Hoyt, Plant Engineer
Towle Manufacturing Company
Newburyport, Mass.

Dear Mr. Hoyt:

Reference is made to your letter, dated November 9, 1977, regarding drainage into Bailey's Pond, from Route I-495 at the junction of Route 150.

The drainage area starts in a swamp north of the Haverhill Road. There is a culvert under Route 110, just west of Hoyt Avenue that consists of approximately thirty (30) feet of 3' X 4' concrete box with extensions of approximately 20' of 4' X 4' concrete box on both sides of the highway, made when the road was widened in 1931.

The water then flows in a brook to a 72" A.C.C.M. pipe under Route 150 extension north of I-495 thence in a ditch to a 4' X 8' R.C. box culvert under the northeast ramp.

Then there is a short section of ditch that runs to another 4' X 8' R.C. box culvert under I-495 east of Route 150 with another section of ditch to yet another 4' X 8' R.C. box culvert that carries the water under both ramps in the southeast quadrant and also under Summit Ave. extension and from there it flows by brook into Bailey's Pond.

Drainage for an Interstate Highway is designed for at least a fifty year storm which accounts for the large culverts.

I am enclosing a Topographic map of the location in question with the approximate drainage area flowing to the pond outlined in red. The brook leading from the swamp to the pond is marked in blue.

Also enclosed are copies of the information on Dry Hydrants as discussed with you by Donald Horgan of my staff.

Please feel free to call on this office if you feel we can be of further assistance.

Very truly yours,

Sherman Eidelmann
District Highway Engineer

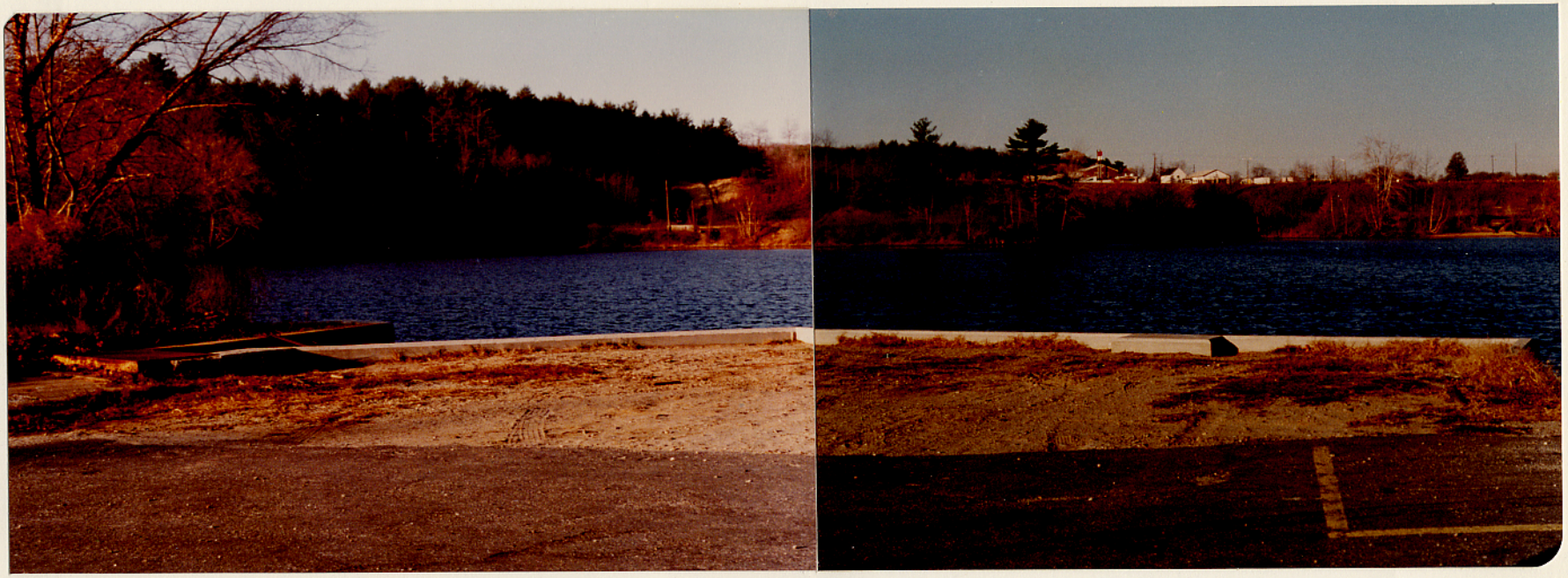
AMD/cr
Enclosure
cc:RTT

APPENDIX C

PHOTOGRAPHS

Note: Location and direction of photographs shown on Figure B-1 in Appendix B.

BAILEY POND DAM



NO. 1 TOP OF DAM AND CONCRETE WALLS

NO. 2 UPSTREAM FACE OF DAM

NO. 3 BOAT LAUNCHING AREA AT NORTH END OF DAM

NO. 4 APPROACH CHANNEL OF SPILLWAY WITH STEEL COVER IN PLACE

NO. 5 APPROACH CHANNEL OF SPILLWAY WITH STEEL COVER REMOVED

NO. 6 PARKING LOT AND FACTORIES DOWNSTREAM OF DAM

NO. 7 18-INCH CONDUIT DISCHARGING INTO MERRIMACK RIVER

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

BAILEY POND DAM

Project Nat. Review of Non Fed. Dams Acct. No. 6356 Page 1 of 7
Subject Essex County, Mass. Compld. By LEE Date 12/10/79
Detail BAILEY POND DAM Ck'd. By WC Date JAN 80

(I) Test Flood, Storage & Storage Functions

1- Total Drainage Area - 0.86 mi²

2- Pond(s) Area: Storm Created Ponds = 0.04
Swamp(s) Area: Swamp N.W. Rte 110 = 0.17
Total Area Pond(s) & Swamp(s): 0.21

% Ponds & Swamps = $\frac{0.21}{0.86}$ = 24.4 %

3- $\frac{175 - 30(\pm)}{10200} = .0142$ } Say Ave Slope = 1.5%

4- Using C. of E. Curves for Peak Flow Rates & above guide values the Peak Flow Rate was estimated to be somewhat above "Flat & Coastal" and taken at 1350 c.f.s./mi²
Size Class: Small; Hazard Pot.: Signif.; Spill. Des. Flood: 100 yr to ½ PMF
Use: Test Flood = 100 yr. storm ≃ ¼ PMF

5- **Test Flood Inflow = ¼(1350) 0.86 = 290 c.f.s.**

6- Pond Storage
The pond area is 0.02 sq. mi. at elev. 27.5. Based on a const. area, storage increases at ± 13 ac. feet per foot of depth increase.

7- Spillway crest elev. is 27.5

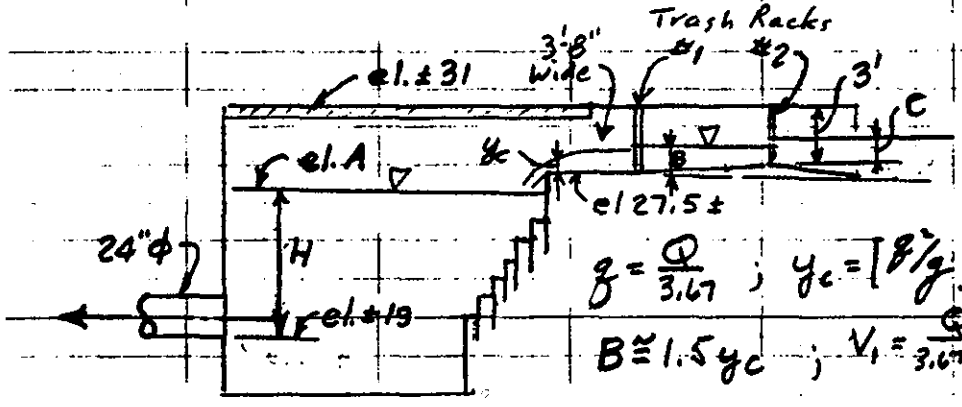
8- Storage Functions are based on $Q_{out} = Q_m\left[1 - \frac{S_{out}}{R}\right]$
S_{out} = Storage Vol. in Reservoir related to final Q_{out} in terms of inches of rain over the drainage area.
S(in Inches) = $12\,D\left(\frac{0.02}{0.86}\right) = 0.279\,D$; R = 6hr rain of storm.
D = Storage depth in feet above spillway crest in reservoir

9- Storage Functions: (Test Flood & ½ PMF - if needed)

F_{TF}	$= 290 - 61.1\,S = 290 - 17\,D$
$F_{½PMF}$	$= 580 - 61.1\,S = 580 - 17\,D$

(II) Discharge Relations

Note: For simplicity assume entrance control @ 24"ϕ pipe. Pipe is long, its path not fully locatable, and two manholes could provide discharge relief, under high flows



$q = \frac{Q}{3.67}$; $y_c = [q^2/g]^{1/3}$

$B \cong 1.5\, y_c$; $V_1 = \frac{Q}{3.67(D)}$

A - Control @ Entrance to 24" ϕ [Ref. V.T. Chow - Fig 17-30]

(estimated; vault under pressure)

H/d	2	3	4	5	6	7	8
el. A	23	25	27	29	31	33	35
Q	27	35	41	47	53	60	66
y_c	1.19'	1.41'	1.57'	1.72'	1.86	2.02	2.16
B	1.8'	2.1'	2.4'	2.6'	2.8'	3.0'	3.2'
V_1	4.1	4.5	4.6	4.9	5.2	5.4	5.6

B - Trash Rack #1

Gross Width 3.63', 1¾" x ⅜" bars @ 1⅜" o.c. plus "other bars"

$h_{R1} \cong 1.5\left(\frac{V_2^2 - V_1^2}{2g}\right)$; V_1 = Appr. Vel., V_2 = Vel. between bars

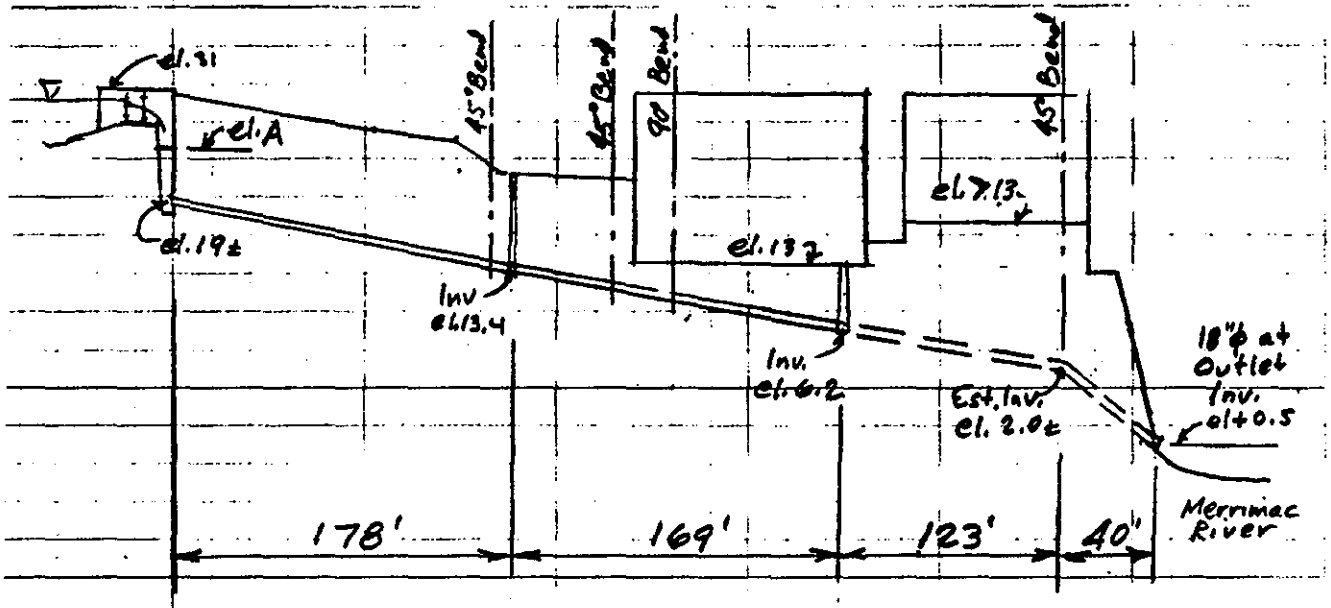
$V_2 = V_1\left(\frac{1\frac{3}{8}"}{1"}\right)(1.05) = 1.44\, V_1$; $V_2^2 = 2.08\, V_1^2$ (1.05 for "other bars")

$\therefore h_{R1} = .025\, V_1^2$

V_1	4.1	4.5	4.6	4.9	5.2	5.4	5.6
h_R	0.4'	0.5'	0.5'	0.6'	0.7'	0.7'	0.8'

(II) Discharge Relations (Cont.)

C - 24" ϕ Pipe (assume most of pipe is 24"ϕ - with short 18"ϕ at end)



Head on Pipe $= H = \frac{V^2}{2g}\left[0.5 + \overbrace{3(0.4) + 0.8 + 1.0}^{\text{bends}} + .02\frac{510}{2}\right]$

$\therefore H = \frac{V^2}{2g}(8.6)$ thus $Q = 8.6\sqrt{H}$

Mean High Water @ El. + 3.9
Mean Low Water @ El - 3.9
Extreme Low Water @ El. - 7.4
} for Newburyport - taken from U.S. C. & G. Chart 1206

1 - Mean High Water - el. + 3.9

El. "A"	23	25	27	29	31	33	35
Q	38	40	41	43	45	46	48

2 - Mean Low Water & Mean Tide - outlet governs (el. 1.25)

El. "A"	23	25	27	29	31	33	35
Q	40	42	44	45	47	48	50

(II) Discharge Relations - (Cont.)

D - Trash Rack #2

Gross Width 6.85', 2½" x ⅜" bars @ 1⅞" oc;

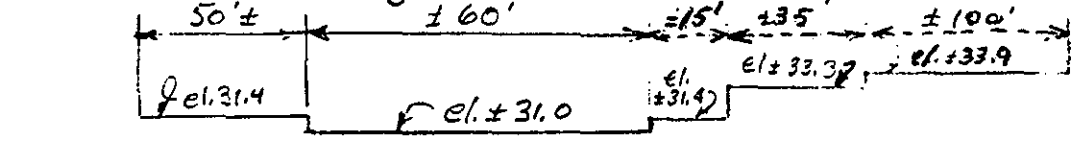
$C = B + h_{R1} - 0.5$; $V_1' = \frac{Q}{6.85C}$, $V_2' = V_1'\left(\frac{1\frac{7}{8}}{1\frac{1}{2}}\right) = 1.25\,V_1'$

$\therefore h_{R2} = .013\,V_1'^2$; Pond El. = 28' + C + h_{R2} (except as noted below)

Q	27	35	41	47	53	60	66
C	1.7	2.1	2.4	2.7	3.0	3.2	3.5
V_1'	2.3	2.4	2.5	2.5	2.6	2.7	2.8
h_{R2}	0.1'	0.1'	0.1'	0.1'	0.1'	0.1'	0.1'
Pond El.	29.6	30.2	30.5	30.8	31.8	33.8	35.4

Pond El. = El. "A" + h_{R1} + h_{R2}

E. Crest Discharge



Crest flow passes down gently sloping, paved parking area. Assume: $q = 2.55\,H^{1.5}$

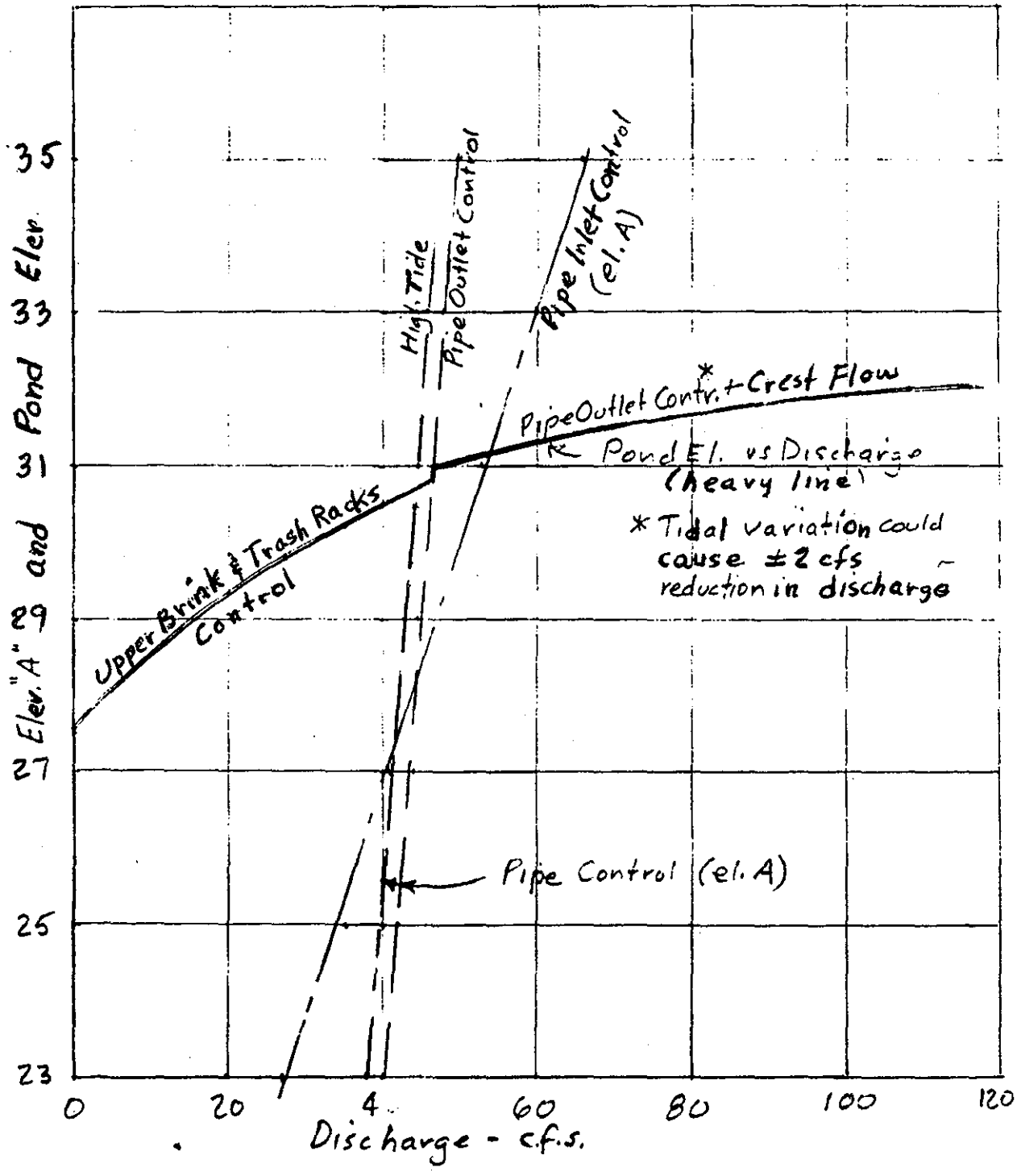
Pond El.	31.5	32.0	32.5	33.0	33.5	34.0
60' @ el. 31.0 - Q_1	50	150	280	430	600	800
65' @ el. 31.4 - Q_2	10	80	190	340	500	690
35' @ el 33.3 - Q_3	—	—	—	—	10	50
100' @ el 33.9 - Q_4	—	—	—	—	—	10
ΣQ	60	230	470	770	1110	1550

(III) Crest Flow

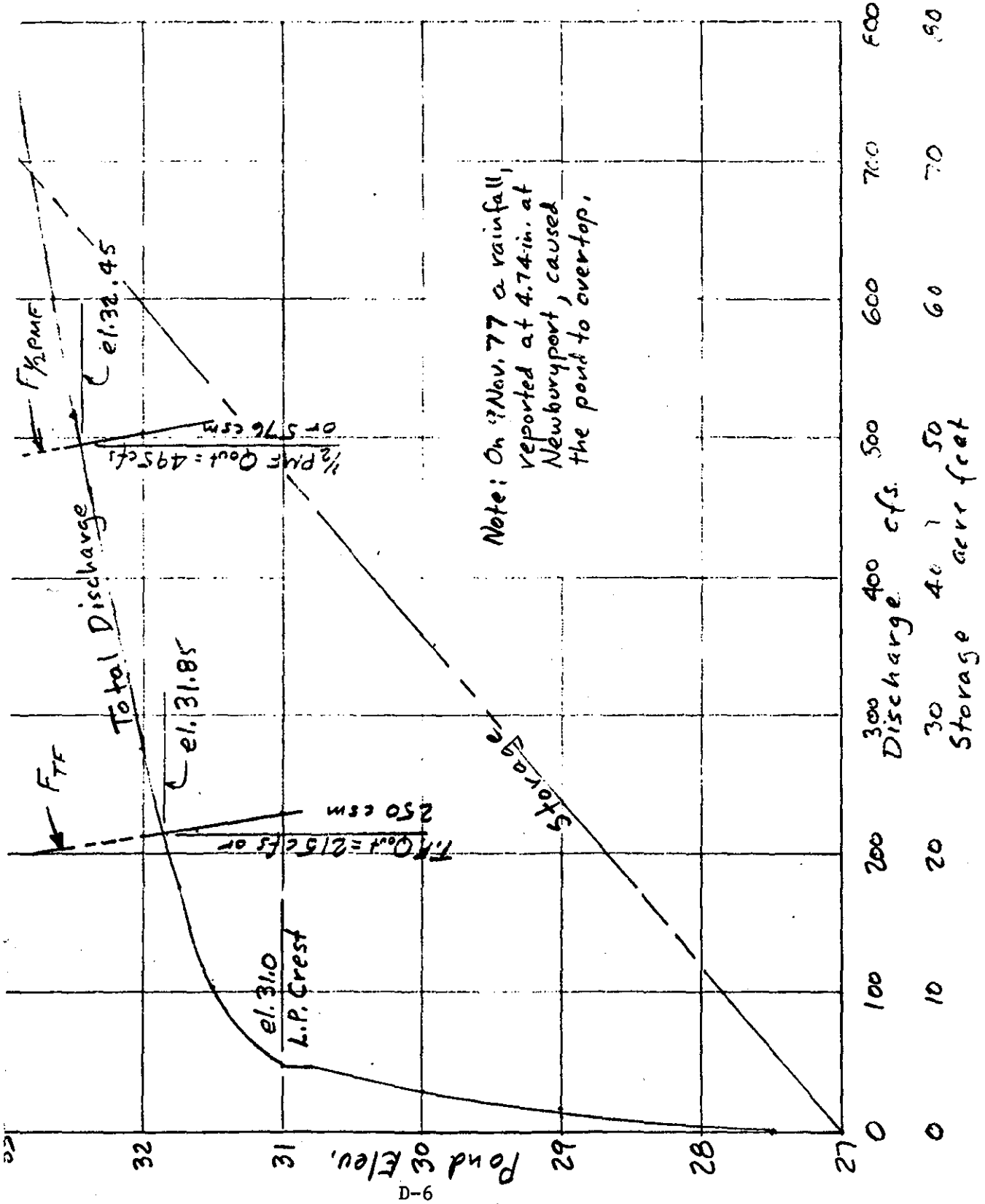
Test flood produces pond elev. 31.85. Depth over crest L.P. of elev. 31.0 is 0.85 ft. $q = 2.55\,(.85)^{1.5} = 2.0$ cfs/ft.

As critical flow: $y_c = 0.50$, $V_c = 4.0$ fps.

(IV) Pond Elev vs Discharge for Low Flows.



(V) Discharge, Storage, & Storage Function vs. Pond Elevation



(VII) Failure of Dam

Peak Failure Flow:

Pond Elevation - 31.0 (L.P. Crest)
Toe Elevation — 22.0 ± (Merrimack St. @ M.H.)
Y_o = 9.0

Dam Length Subject to Breaching = 60' (Proj. length conc wall)
$W_o = 40\%(60') = 24'$

$$Q_{P_1} = 1.68\, W_o (Y_o)^{1.5} = 1.68(24)(9)^{1.5} = 1100 \text{ cfs}$$

Storage Volume Released:

Storage Above Spillway $13(3.5) =$ 46 ac-ft
Storage Below Spillway $13(15)\frac{1}{3} - \frac{9.5}{15}(13)(9.5)\frac{1}{3} =$ 39 *
S = Total Storage = 85

* Pond is assumed to be 15' deep below spillway - but failure cut is unlikely to be lower than Merrimack St.

Downstream Hydraulics:

Failure flow would impact against the factory, and generally turn southwest down Valley Road, passing thru a critical depth.

For 50' wide street: $q = \frac{1100}{50} = 22 \text{ cfs/ft}$, $y_c = 2.47'$, $V_c = 8.91$, $h_{v_c} = 1.23'$

The pool against the factory wall below the failure would be $y_c + h_{v_c} = 3.7'$ deep (at least)

"Normal" flow down Valley Road at Vel. $= \frac{1.49}{.013} R^{2/3} \left[\frac{21.3-18.3}{116}\right]^{1/2} = 18.43\, R^{2/3}$

Assume $R \simeq y$ ∴ $Q = 1100 = VA = 18.43\, y^{2/3}(50y) = 921.5\, y^{5/3}$; $y = 1.11'$

Vel. in street $= \frac{1100}{1.11(50)} = 19.8$ fps., $h_v = 6.09'$

Due to insufficient energy, flow would not become "normal" before reaching the Merrimac River - ∴ flow in the street would be similar to critical - say $y \simeq 2'$, $V \simeq 11$ fps.

Time to Drain:

$$\frac{43560\,(85)}{3600(\frac{1}{2})(1100)} = 1.9 \text{ Hours.}$$ - does not include time for erosion to occur thru dam.

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

BAILEY POND DAM